

CHAPTER 13

WORK BEYOND CAPABILITY OF SHIP'S FORCE

As electronics material officer, you are responsible under the operations officer for advising the commanding officer of the necessity for repairs to electronic equipment and of the appropriate priorities to be assigned to individual repair items. To do this you must know the condition of your equipment. You must know the purposes of the various types of ship availabilities, and the kinds of repairs which may be accomplished during each type of availability. You must also understand the regulations governing the accomplishment of alterations and the kinds of assistance available through contract field service technicians.

REPAIR ACTIVITIES

Ships cannot operate reliably without repairs. To keep a ship in prime condition, constant attention should be given to material upkeep, and definite intervals of time must be allotted for general overhaul and repair. Even when routine planned maintenance procedures and schedules are carefully observed, damage due to storms, collisions, fires, etc., may necessitate emergency repair work beyond the capability of ship's force. Repairs and alterations to naval ships may be accomplished by forces afloat (including repair activities afloat) or repair activities ashore.

LEVELS OF SHIP MAINTENANCE

There are three levels of ship maintenance: organizational level maintenance, intermediate level maintenance within the capability of forces

afloat and certain fleet support bases, and depot level maintenance within the capability of the Shore Establishment.

As a general policy, ship maintenance requirements will be accomplished at the lowest level of maintenance, consistent with capabilities, capacity and resources, in order to maximize operational readiness of fleet units.

Repairs and authorized alterations to ships and their equipment not requiring the facilities of a shore based activity shall, as far as practicable, be accomplished by forces afloat. Commanding officers of ships endeavor to have all such work done by the ship's force when practicable.

ORGANIZATIONAL (SHIPBOARD) LEVEL MAINTENANCE

Organizational level maintenance is that maintenance level which is the responsibility of and performed by the ship's force on assigned equipment.

The individual ship is self-sufficient to the maximum degree. The Planned Maintenance System, described in the Maintenance and Material Management (3-M) Manual (OP-NAVINST 4790.4), defines the minimum preventive maintenance program to be carried out on board ship. This manual also describes the use of 3-M MDS products, including machine produced CSMP and work requests as maintenance management tools. It is a command responsibility to ensure that this maintenance is effectively planned, scheduled and accomplished.

INTERMEDIATE LEVEL MAINTENANCE ACTIVITY (IMA)

Intermediate level maintenance is that maintenance which is normally performed by Navy IMA personnel on tenders, repair ships, aircraft carriers, fleet support bases, and Shore Intermediate Maintenance Activities (SIMAs). It normally consists of calibration, repair or replacement of damaged or unserviceable parts, components, or assemblies; the emergency manufacture of unavailable parts; and providing technical assistance to using organizations.

Intermediate level maintenance activities utilize the 3-M System to develop and process the maintenance actions for IMA upkeep periods including early identification and assignment of work items to maximize utilization of resources. This program is described in the Maintenance and Material Management (3-M) Manual (OPNAVINST 4790.4).

Forces afloat and fleet support base activities which are manned by Navy personnel will accomplish ship maintenance to the maximum extent feasible consistent with the availability of material, funds and skilled manpower.

The role of tender and repair ships is two fold: (1) a deployment maintenance asset for contingencies, and (2) a valuable maintenance asset under peacetime conditions. Maximum utilization of these IMA assets to repair ships and installed equipment beyond the capability of the ship's force supports this concept. Further, efficient utilization of IMAs optimizes this investment and, in the long term, reduces repair requirements for depot level maintenance.

DEPOT (SHIPYARD) LEVEL MAINTENANCE

Depot level maintenance is that maintenance performed by industrial activities on material requiring major overhaul or a complete rebuilding of parts, assemblies, subassemblies, and end items. This includes the manufacturing of parts, modifications, testing and reclamation as required. This is normally accomplished on ships at commercial facilities or naval shipyards, including ship repair facilities, during restricted availabilities, technical availabilities and regular overhauls.

Overhauls

Ships in the U. S. Navy shall undergo regular overhauls, at the approximate intervals and of the duration set forth in OPNAVINST 4700.7 (Series), in order to accomplish major maintenance and modernization. The only work to be scheduled for accomplishment by depot level maintenance activities will be that which, in the judgment of the type commander, (1) is not feasible to be accomplished by organizational or intermediate level maintenance activities because of insufficient time, manpower, or because it is beyond the capabilities of the fleet maintenance activities, or (2) is of such a nature that split responsibility between fleet and depot maintenance activities should be avoided. Materially, a ship leaving a repair activity upon completion of its overhaul normally shall be ready for unrestricted war service. All regular overhauls shall be planned to provide for the accomplishment of all outstanding repairs and major maintenance necessary to ensure reasonably reliable material readiness and operations during the succeeding operational cycle. If this level of maintenance cannot be attained within available resources, the Fleet Commanders in Chief shall make appropriate recommendations to the Chief of Naval Operations, providing detailed information.

SHIP'S FORCE MAINTENANCE AND REPAIRS

Each ship should, insofar as practicable, be self-sustaining with regard to normal repairs. Each ship should be well supplied with materials, repair parts, and tools and equipment so that much of its own repair work can be accomplished by ship's force. Repairs should be undertaken under the supervision of the most competent and experienced personnel. Personnel not familiar with specific repairs and tests should be instructed to take advantage of shipyard or IMA availabilities (IMAVs) or tender assignments to observe how such work is undertaken. Technical assistance should also be requested from Mobile Technical Units (MOTUs) and NAVSEA/NAVELEX field activities when needed.

The purpose of preventive maintenance is to maintain satisfactory material conditions and ensure that the equipment or machinery is always ready for service. A regular schedule of cleaning, inspections, operations, and tests is required to ensure trouble-free operation and the detection of incipient faults before they develop into major sources of difficulty.

Most routine inspections and tests are performed by ship's force under the planned maintenance system. Some of these inspections and tests are quite simple, while others require planning so that they can be undertaken during upkeep or overhaul periods. Outside and repair ship assistance should not be requested unless the test or inspection is actually beyond the capability of ship's force.

An interdepartment routine request for work requiring assistance by another shipboard department is accomplished via the OPNAV 4790.2K Maintenance Form. This form enforces proper channeling of a work request between departments, and permits the setting up of priorities of available manpower and facilities.

AVAILABILITIES

The control and disposition of a ship is at all times a function of certain operating commands. A commanding officer may not, informally and on his/her own initiative, take the ship to a shipyard or alongside a tender or repair ship for repairs. Instead, when there is a need for outside assistance, the commanding officer informs the type commander, or in some cases, the operational commander, who assigns an availability at a repair activity. There are several types of availabilities which vary with the purpose of their assignment.

RESTRICTED AVAILABILITIES

A Restricted Availability is an availability for the accomplishment of specific items of work by an industrial activity, normally with the ship present, during which period the ship is rendered incapable of fully performing its assigned mission and tasks due to the nature of the repair work. (This availability usually applies to Navy and commercial shipyards.)

TECHNICAL AVAILABILITY

A Technical Availability is an availability for the accomplishment of specific items of work by an industrial repair activity, where ship need not be present, during which period the ship's ability to fully perform its assigned mission and tasks is not affected by the nature of the repair work. (This availability usually applies to shipyards.)

REGULAR OVERHAUL

A Regular Overhaul is an availability for the accomplishment of general repairs and alterations at a naval or commercial shipyard and is normally scheduled in advance and in accordance with an established long range cycle. See Table 13-1 for OPNAVINST 4700.7 (Series) Overhaul Schedule for Ships.

VOYAGE REPAIRS

Voyage Repairs are emergency repairs necessary to enable a ship to continue on its mission and can be accomplished without requiring a change in the ship's operating schedule or the general steaming notice in effect.

INTERMEDIATE MAINTENANCE ACTIVITY (IMA)

An IMAV is an availability for the accomplishment of general repairs and authorized alterations which are beyond the capacity of the ship's force alongside a tender or repair ship, or at a SIMA. It is normally scheduled in advance.

EMERGENCY TENDER AVAILABILITY

An Emergency Tender Availability is assigned to a ship for the purpose of rendering repairs to specific casualties. Emergency work takes first priority on a tender capacity.

PARENT TENDER/AUTOMATIC AVAILABILITY

A Parent Tender/Automatic Availability is an availability for the accomplishment of items of work, usually on a ship-to-shop basis. The

SHIPBOARD ELECTRONICS MATERIAL OFFICER

Table 13-1.—Ship overhaul scheduling

Ship Type	Overhaul/Duration Interval (months)	Ship Type	Overhaul/Duration Interval (months)
AD	5/48	DE	6/37
AE	5/48	DEG	6/37
AF	3/37	DLG	9/37
AFS	5/48	DLGN	RF 10/60
AG	3/38		RO 10/60
AG (Ex-MSO)	2/24	LCC	6/40
AGDE	6/37	LHA	6/40
AGF	5/40	LKA	4.5/40
AGP	4/44	LPD	4.5/40
AGSS	6/30	LPH	5.5/40
AH	3/37	LSD	5/40
AO	5/48	LST	4/44
AOE	7/48	MSC	2/24
AOR	7/48	MSO	2/24
AR	4/48	PG	3/24
ARS	4/42	PHM	1.5/18
AS	5/48	SS	8/30 ^{1/}
AS (FBM)	5/60	SSN 578 CL	18/55
ASR	4/37	588 CL - RF	17/43
ATF	3/37	RO	14/43
ATS	4/42	594 CL - RF	16/70 ^{4/}
CG	8/42	RO	13/70 ^{4/}
CGN	RF 12/60	637 CL & 671 - RF	15/70 ^{4/}
	RO 12/60	RO	13/70 ^{4/}
CLG	8/42	596/603/605/607 - RF	16/43
CV/CVA	9/48	RO	13/43 ^{2/}
CVN	RF ^{1/48} ^{2/}	575/585	^{1/43} ^{2/}
	RO 9/48	587	^{1/55} ^{2/}
CVT	6/36	597	^{2/}
DD (FRAM)	4.5/37	SSBN	^{3/}
DD (931/945)	7/37		
DD 963	3/46		
DDG	9/37		

^{1/}The operating interval may be extended to a maximum of 36 months when warranted by known material conditions of the ship. Submerged operations after 36 months of operations should not be scheduled. If such operations are required by military necessity, a thorough material inspection (to include drydocking) followed by intensive maintenance to correct deficiencies must be conducted.

^{2/}Unique duration and/or interval.

^{3/}See OPNAVINST S3120.23G for additional information on SSBN overhaul planning.

^{4/}Following entry into IMMP (43 month interval prior).

repairs are normally of a nonoperational nature and done by a tender or repair ship on an unscheduled basis. (This availability is not used in SURFLANT.)

A Concurrent Availability is an availability for the accomplishment of ship-to-shop work by

the tender or repair ship scheduled to coincide with the regular shipyard overhaul or restricted availability.

An Integrated Logistics Overhaul Plan is a period of time assigned a ship for the uninterrupted accomplishment of a supply overhaul.

The overhaul is the purification and adjustment of on-board stocks and records to bring them into conformity with prescribed allowances or other stockage objective criteria. The ILOP is normally scheduled to coincide with a regular overhaul.

In addition to the definitions of the availabilities assigned naval ships, this chapter presents the procedures for the accomplishment of the shipwork (alterations and repairs) associated with ship availabilities and the repair activities that accomplish the work.

REPAIR SHIPS, AND TENDERS AND SIMAs

Repair ships, tenders and SIMAs have a certain degree of specialization although all of the ships have many characteristics and facilities in common which make them suitable for general repair work regardless of their designation. Repair activities afloat include the following:

1. Repair Ships, AR
2. Destroyer Tenders, AD
3. Submarine Tenders, AS

Repair ships and tenders are designed to perform battle and operational damage repairs on ships in the forward areas and to perform logistic support to ships of the fleet. In addition, they are capable of providing services, including medical and dental treatment, for ships tended. Their shops consist of components necessary for hull, machinery, electrical, electronic, and ordnance work. The repair parts stocked consist of a wide variety of parts for hull and machinery equipment, plus gyro parts, navigational equipment, typewriter repair parts, interior communications equipment, electronics items, motion picture equipment, and many others.

In order to provide adequate facilities for unusual repair requirements and to meet varying operational commitments, particularly of ships deployed outside the continental United States, the ship assignments to the various repair activities afloat are flexible. The final assignment is usually made by message, designating the activity and the period and type of availability.

Ships are scheduled for an Intermediate Maintenance Availability (IMAV) or an upkeep period alongside repair ships or tenders at certain time intervals which vary with different types of ships. The availability periods, which are usually planned well in advance, depend upon the quarterly employment schedule of the ship concerned.

When a ship receives its employment schedule, or is otherwise notified, it can ensure the necessary paperwork is completed in advance of the scheduled availability period. This should be the result of deferred work being documented on CSMP on a continuing basis. The requirement for maintenance assistance (work request) is accomplished on the Maintenance Data Form (OPNAV Form 4790-2K).

Automatic Work Requests (OPNAV 4790/2R), prepared from up to date CSMP information, are sent with a forwarding letter to the type commander or authorized representative. The staff officer handling material and maintenance screens the work requests. Most of the ship's availability worklist items are approved and authorized. However, the ship may have to furnish more detailed information on certain work requests. The amount of corrective action taken by the reviewing staff officer will depend upon how well the work requests are written and the extent to which they follow established policies and procedures. Upon the completion of this screening, the ship's work requests are forwarded to the Readiness Support Group (RSG) for assignment. This is done well in advance of the assigned period of availability so that the repair department personnel can schedule the work and make any necessary preparations.

Repair Personnel

The commanding officer is assisted in the discharge of responsibilities by the executive officer, who acts as the CO's direct representative and is charged with the performance of those functions which affect the ship as a whole, and with coordinating the activities of all departments and divisions of the ship.

General information concerning the relative positions and responsibilities of departments can be obtained from OPNAVINST 3120.32 (Series). In addition to this general publication, type commanders issue standard ship organizations for their type, which give detailed descriptions of the organization for every routine function and for most emergency conditions which can exist on board ship.

The sections which follow deal with the repair officer, the assistant repair officer, the repair division officers, the diving and salvage officer, the gas-free engineer, and enlisted personnel.

REPAIR OFFICER.—On a repair ship or tender where repair of ships is a primary function, the repair officer is the head of the repair department. The repair officer is charged with the accomplishment of repairs on those ships granted availabilities by competent authority.

The first responsibility of the repair officer is Quality Assurance in accordance with the QA Manual. The responsibility includes supervision of a well-organized and efficiently operated department; or, in other words, ensuring that subordinates are performing as required.

ASSISTANT REPAIR OFFICER.—The assistant repair officer is charged with the responsibilities of the repair officer during that officer's absence. Otherwise he/she will carry out those responsibilities which the repair officer may delegate.

GAS-FREE ENGINEER.—On repair ships and tenders, the hull repair officer is generally assigned additional duty as the gas-free engineer. The basic function of the gas-free engineer is to ensure that there is no danger of suffocation of personnel, or hazard to personnel or equipment, from noxious or explosive gases during any operation aboard ship or during work on ships alongside.

ENLISTED PERSONNEL.—The technical skills required aboard repair ships and tenders are provided by Navy enlisted personnel. You should become familiar with the standard ship organization of a repair ship or tender

(OPNAVINST 3120.32 (Series)). Detailed information on the enlisted rating structure can be obtained from the *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards*, NAVPERS 18068 (Series).

Arrival Conference

When a ship comes alongside for a regular tender availability or an upkeep period, an arrival repair conference is usually held immediately. The conference is attended by representatives of the ship, of the repair department, and (usually) of the type commander. The needs of the ship and the urgency of each job are discussed. The arrival repair conference serves to clarify all uncertainties for repair department personnel, who have received and studied the work requests in advance.

Arrangements are also made for the repair ship to provide the primary services of steam and electricity to take care of heating and lighting requirements and to provide limited power for ships alongside. In addition to these services, the repair ship may take over communication watches commensurate with the type of repairs being accomplished. Fresh water and fuel requirements are not usually supplied except from barges.

The repair department in a repair ship or tender effects repairs in a manner similar to that of a production department in a naval shipyard, even to the extent of assigning ship superintendents as representatives of the repair officer.

Work Requests

Work requests are made up by the ship and are forwarded through proper channels to the repair activity. As soon as the work requests have been approved at the arrival conference, the jobs that require delivery to the tender should be started. It is very important to start these repair jobs early so all necessary jobs can be completed within the allotted availability period. Equipment that is not needed for the operation of the ship may be disassembled in advance so that the defective parts can be delivered

to the tender as soon as the work requests have been approved.

All material delivered to the tender must be properly tagged and identified. The information on each tag should include the number and name of the ship; the department, division, or space; and the work request number and the division representative for that job. Additional information should be included if necessary. Reference material such as blueprints and manufacturers' technical manuals should be identified with the ship's name and number.

Ship-to-Shop Jobs

Many repair jobs are designated by the ship or approved by the repair activity as "ship-to-shop" jobs. In a job of this type, the ship's force does a large part of the repair work. Ship's force may complete partial/complete disconnect of a piece of equipment and deliver it to the tender along with required publications. The shop supervisor checks the equipment and gives the approximate time of repair completion. After repair, ship's force often picks up the equipment, installs it and tests it to ensure satisfactory performance.

Checking Progress of Tender Work Requests

Tender repairs that are being accomplished on a ship can be checked by discussing them with the petty officer in charge of the repair detail. The petty officer in charge should know at all times the status of repair work (including ship's force repair work) being done for the space or equipment. Checking on the progress of work in the shops on the tender requires planning and coordination between the ship and the tender. Personnel in the tender shops are busy with their repair work, so any method used to check on progress of work must be one which does not interfere.

SHIP SUPERINTENDENT.—Some tenders and repair ships have a chief petty officer who acts as ship superintendent, handling

all problems and being in direct contact with ship personnel. The duties include:

1. Acting as liaison officer between the ships alongside and the tender in regard to repair department jobs
2. Acting as a coordinator of shop work for assigned ships
3. Reporting daily to a representative of the ship
4. Maintaining a daily running progress report or chart which indicates the percentage of completion of each job; the availability of plans, manufacturers' technical manuals, samples, etc.; and the availability of materials required for each job. (Keeping a close watch on the progress of the repair work will ensure that jobs are not unnecessarily delayed, that jobs are not overlooked or forgotten, and that all work undertaken is satisfactorily completed at the end of the repair period. For the convenience of customer ships, repair ships with computer systems generally print out, on the average of three times a week, a status of work in the repair shops).
5. Notifying the ship when it is time to pick up completed work from the tender
6. Notifying ship's personnel when it is necessary for them to witness tests needed because work has been performed on machinery, compartments, and tanks
7. Obtaining signatures from officers if work requests are canceled or changed
8. Ensuring that QA requirements are met in all work and testing of ship equipment

If the tender provides a ship superintendent, it is quite easy for ship's personnel to check on the progress of the work. If the services of a ship superintendent are not provided, the ship alongside the tender generally appoints a petty officer to perform similar duties for the division or department.

REPAIR SHOPS

You will need a general knowledge of the repair department shops and their functions in order to have a complete conception of the

repair department potential as a whole. The shops will be described in groups corresponding to the divisions that exist in the organization of a typical destroyer tender, AD, which is fairly representative of most tenders.

**R-1 Division,
Hull Repair Officer**

SHIPFITTER SHOP.—Accomplish all types of hull repairs; perform aluminum and steel welding on hull structures and hull appurtenances; spot weld, braze, and solder where applicable; join hull platings using rivets or fasteners as plans indicate; repair water-tight doors and heavy gage ventilation ducts; test padeyes and structures with dynamometer; and accomplish pertinent alterations designated for accomplishment by Forces Afloat.

SHEET METAL SHOP.—Accomplish all types of light gage sheet metal repairs and fabrication; fabricate aluminum and sheet metal lockers, shelves, furniture, ventilation ducts, ventilation screens, strainers, lightweight covers for protection of machinery, safety guards, brackets, and other items where light gage sheet metal or aluminum plate is required; arc weld, aluminum weld, spot weld, braze, and solder where applicable; and accomplish pertinent alterations designated for accomplishment by Forces Afloat.

PIPE AND COPPER SHOP.—Fabricate and repair, within limitations of shop equipment, pipe and tubing of steel, copper, copper-nickel alloy, stainless steel and brass; arc weld, silver solder, braze and solder piping and tubing as required; test completed work hydrostatically as required in job specifications; and accomplish pertinent alterations designated for accomplishment by Forces Afloat.

WELD SHOP.—Weld fabrications of steel, aluminum, brass, copper, stainless steel, and cast iron; accomplish high pressure welding on boilers when authorized to do so; repair castings and other work requiring use of arc and aluminum welding, brazing, silver solder and solder; preheat and stress relieve castings and forgings; forge special tools and hull fittings;

case harden low carbon steel. (NOTE: The nondestructive testing laboratory performs all nondestructive testing, used for testing the quality of the welds.)

CARPENTER SHOP.—Accomplish all types of fabrications and repairs requiring the use of wood, such as ship's gangways, lockers, furniture, boxes, crates, signs, decorations, boats, boat ALTS and shoring, test damage control air test equipment, safety flame lamps, and explosion meters; lay linoleum tile, magnesite, terrazzo covers on decks; and fill CO₂ bottles.

The pattern shop, which functions under the carpenter shop, fabricates patterns of wood for templates and foundry castings.

DIVING LOCKER.—Inspect underwater portion of hull and prepare underwater hull report, where used, for the Repair Officer; replace propellers (destroyers and small ships), rope guards, and fairwaters; plug hull openings for removal of sea valves; tighten rudder nuts; remove broken-bilge keels; accomplish minor welding and cutting underwater; clean propellers, sonar domes, sea chests, and large injection valves; clear fouled propellers and sea chests; and maintain diving boat and diving equipment in repair and operational readiness.

CANVAS SHOP.—Fabricate miscellaneous canvas covers and awnings, using number 1- number 12 weight canvas; fabricate boat cloths; and repair furniture using leatherette and cloth fabrics.

**R-2 Division,
Machinery Repair Officer**

INSIDE MACHINE SHOP.—Repair or fabricate mechanical parts which require matching on lathes, milling machines, boring mills, shapers, grinders, and drill presses; press on or remove bushings, bearings, shafts, and other work requiring use of the hydraulic press; saw metal; spray metal; engrave label plates; balance rotors; test metals using Rockwell metal hardness tester; and accomplish pertinent machinery alterations designated for accomplishment by Forces Afloat.

OUTSIDE MACHINE SHOP.—Repair all types of machinery used in naval ships such as high and low pressure globe and gate valves, relief valves, boiler safety valves, reducing and regulating valves, and steam traps; test and set gages; fabricate flexible remote control cable; repair, adjust, and test shipboard mechanical machinery such as steering engines, anchor windlasses, boat and bathythermograph winches, pumps, main propulsion turbines, generator turbines, forced draft blowers, and auxiliary machinery turbines, fit bearings; align shafts and bearings; and accomplish pertinent machinery alterations designated for accomplishment by Forces Afloat.

BOILER SHOP.—Inspect boilers of naval ships; bend and replace boiler tubes; repair soot blower elements and soot blower heads; grind superheater hand hole seats; reseal economizer plugs; supervise repair of brickwork and refractory materials; supervise welding of pressure parts; repair or replace manhole studs; replace steam drum protection plates, water drum protection plates and superheater seal plates; test feed water; repair flow indicators and other air and water indicating instruments; retube condensers and heat exchangers; and perform other necessary boiler work within the capability of personnel and shop equipment.

FOUNDRY SHOP.—Pour castings of steel, cast iron, Monel brass, copper, and aluminum; and pour bearings.

**R-3 Division,
Electrical Repair Officer**

ELECTRIC SHOP.—Inspect, repair and make adjustments to generators, motors, transformers, magnetic coils, switchboards, and test panels; rewind a.c. and d.c. motors; set and adjust voltage regulators; renew cable; test motors and circuits for overload; accomplish electrical SHIPALTS designated for accomplishment by Forces Afloat; set and calibrate electric meters and instruments; ground test and repair circuits; accomplish other miscellaneous electrical repairs applicable to naval ships; and provide tended ships with

technical assistance for repairs to their own electrical equipment.

GYRO SHOP.—Inspect, repair, and make adjustments to gyro compasses, dead-reckoning equipment, underwater logs, motion picture projectors, automatic telephone systems; repair interior communications (IC) circuits; perform other miscellaneous IC repairs applicable to naval ships; accomplish IC equipment SHIPALTS designated for accomplishment by Forces Afloat; and provide tended ships with technical assistance for repairs to their IC equipment.

PRINTING SHOP.—Accomplish all printing and typesetting in conformance with Department of the Navy printing regulations for publication, and Government printing regulations. Fabricate nameplates and label plates.

PHOTO SHOP.—Provide photographic and printing services as authorized.

**R-4 Division,
Electronics Repair Officer**

ELECTRONICS SHOP.—Repair and align all types of radars, radar repeaters, communications transmitters and receivers, and ESM equipment used in naval ships; replace antennas; accomplish Field Changes; provide tended ships with technical assistance for repairs to electronic equipment; maintain an electronics publications library; and do micro-miniature (2M) repair.

CALIBRATION SHOP.—Repair and/or calibration of test equipment associated with surface/air search radars, sonars, communication and electronic countermeasure equipment, and gun fire control and/or guided missile fire control systems.

TELETYPE SHOP.—Repair and/or calibration of tty equipment.

CRYPTO SHOP.—Crypto repair and/or calibration.

**R-5 Division,
Ordnance Systems Repair Officer**

ORDNANCE SHOP.—Accomplish repairs to gun mounts, receivers, regulators, loading machines, projectile and powder hoists, and missile-launching systems; make casualty analysis and direct repair of all mechanical hydraulic gun equipment; take star gage readings on gun mounts; bore-search gun barrels for defects; re-gun mounts; accomplish required alterations designated for accomplishment by Forces Afloat; inspect magazine sprinkling systems; and provide tended ships with technical assistance for repairs to ordnance equipment.

FIRE CONTROL SHOP.—Conduct tests of electrical fire control circuits for continuity, grounds, and short circuits; repair circuits; repair, adjust, and calibrate fire control radars; test, repair or replace, and adjust mechanical and electrical components of fire control equipment; analyze results of transmission, alignment, computer, and rate tests to determine need for repairs and adjustments; analyze failures and make repairs to target-designating equipment; conduct shipboard test of gyro-controlled computing mechanisms such as lead computing sights and other gyros used in fire control equipment; and provide tended ships with technical assistance for repairs to fire control.

SONAR AND UNDERWATER FIRE CONTROL SHOP.—Repair, test, and calibrate all types of sonars, underwater fire control systems including depth finders, used in naval ships; provide calibrated hydrophone to tended ships for calibrating their own units; accomplish Field Changes and provide tended ship's personnel with technical assistance for repairs to sonar equipment.

OPTICAL SHOP.—Repair, calibrate, and/or collimate binoculars, mounted ship's telescopes, OOD's and Quartermaster's spyglasses, borescopes, gunsight telescopes, and telescopes; repair parallel motion protractors; and repair magnetic compasses.

INSTRUMENT SHOP.—Clean, repair, and adjust all models of clocks, timers, comparing watches, and sinuous course clocks.

Clean, repair, and adjust typewriters; make minor adjustments to calculators, adding machines, duplicating machines; and clean, repair, and calibrate tachometers.

DRAFTING SHOP.—Draft sketches and reproduce drawings; operate ozalid machine; prepare blueprints and black line prints from tracings; paint signs; and sketch and paint artwork as required.

In addition to the repair shops within the repair department, facilities assigned to other departments in the tender or the repair ship assist the repair department by accomplishing certain repair functions. The battery shop, the internal combustion engine shop, the refrigeration shop, and the oil and water test laboratory may be assigned to the engineering department. Services such as compressed air, auxiliary steam, electricity, fresh water, and feed water are supplied to ships alongside by divisions of the engineering department. The deck divisions of the weapons department (deck department on ships without a weapons department) furnish mooring lines, brows, cargo handling facilities, boat transportation, and other services to the ships being repaired or tended. On a repair ship or tender having a weapons department, the torpedo workshop and the special weapons shop may be assigned to the divisions within the weapons department. In fact, all of the departments of the tender or repair ship may be considered to be service departments which the repair officer coordinates, as necessary, to meet the requirements of ships being tended or repaired. Medical, Dental and Supply departments complete the services available.

The functions in most AR and AS shops are similar to those on the AD. The AS, however, has additional shops, such as the rubber shop which is equipped for thermosetting tube grommets or rubber-covered electric cable. The shop manufactures any T-type gasket up to 18 inches in diameter and any molded rubber product within limits of the press. Other shops are the submarine battery shop for the repair,

rebuilding, or cycling of submarine storage batteries, and the special weapons shop with special tools adapted to whatever special devices are currently employed with torpedoes or submarines. The submarine engine shop which operates under the outside machinist section contains special tools adapted to General Motors or Fairbanks, Morse Diesels, and also special equipment adapted to the repair of high pressure air systems.

SHIP REPAIR FACILITIES

Typically, a ship repair facility (SRF) is located outside the continental limits of the United States; employs civilian personnel indigenous to the country in which it is located; Guam; Subic Bay, Philippines; and Yokosuka, Japan. The SRF is supervised by naval officers assisted by enlisted and civil service personnel. The SRF will have drydocks and shops capable of accomplishing nearly all ship repair work. Typical utilization includes voyage repairs and overhaul of ships whose home ports are in the area. No new construction is accomplished.

The mission of a ship repair facility is as follows:

1. Provide logistic support, including drydocking, overhaul, repair, alteration, and conversion of naval ships and service craft and ships of other government departments, as assigned
2. Perform voyage repairs and related work, including drydocking of naval ships
3. Install and maintain shore-based electronic equipment and provide technical guidance to assigned naval activities
4. Perform additional related functions requested by competent authority

For the EMO, services such as calibration lab work, crypto repair, antenna repair, and other electronics work are available.

NAVAL SHIPYARDS

Naval shipyards, under the management control and technical direction of the Naval Sea

Systems Command, are operated to perform the following tasks and functions:

1. Provide logistic support to activities and units of the active fleet of the U.S. Navy and the naval shore establishment
2. Perform authorized shipwork in connection with the new construction, conversion, overhaul, repair, alteration, activation, inactivation and outfitting of naval ships and service craft
3. Design naval ships
4. Operate as planning yards for ship alterations and prepare allowance lists for ships under construction and conversion
5. Perform research, development, test, and evaluation work as assigned
6. Serve as primary and secondary stock points for designated material controlled by Systems Commands and offices of the Navy Department
7. Provide accounting, civil payroll, public works, industrial relations, medical, dental, berthing, messing, fire protection, security, and other services to naval activities and other government agencies, as assigned
8. Perform work for other U.S. Government departments, private parties, and foreign governments, as directed by competent authority

Shipyards management comprises all elements of administration, from the shipyard commander to the individual who is charged with supervision of the smallest group. The management is charged by the Navy Department with the complete administration, coordination, management, operation, and technical control of all phases of naval shipyard activity. The line of authority and control passes from the shipyard commander through the heads of departments, divisions, and offices to the administrative units. Additional information concerning administration and organization of naval shipyards, can be obtained from Navy Department directives. The organization of a typical U.S. Naval shipyard is illustrated in figure 13-1.

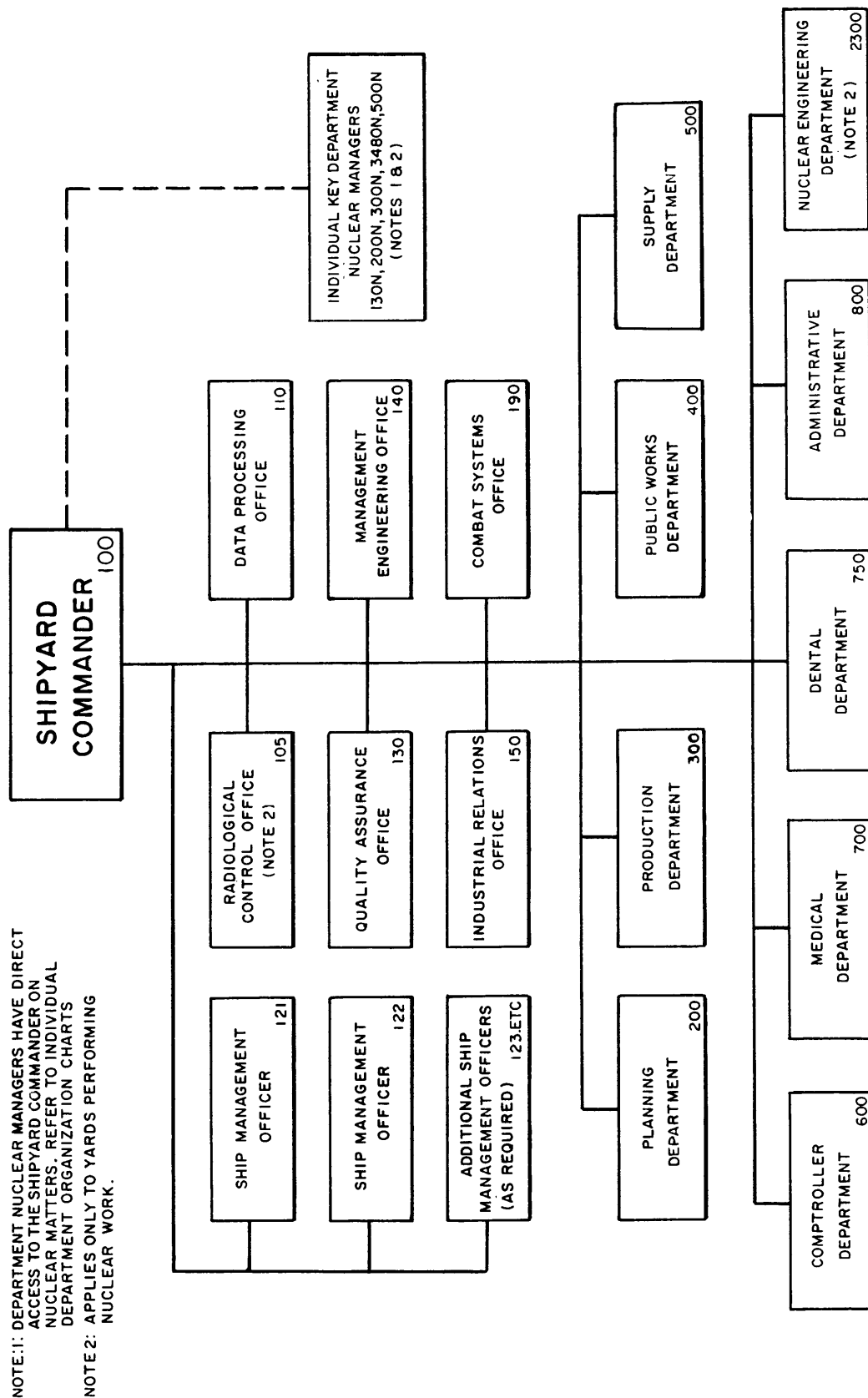


Figure 13-1.—Organization of a typical naval shipyard.

64.16B

OVERHAUL

The periodic overhaul of Navy ships requires substantial investments of resources—personnel, money, material, and time. The Navy's normal high standards of management and the increasing cost of overhaul work, coupled with severe limitations on funds, make it essential to achieve the very best possible results from the resource investment. Achieving these results requires comprehensive advance planning for ship overhauls and judicious management of overhaul work. The advance planning process for the routine overhaul of a U.S. Navy ship is the foundation of a successful overhaul, and the ship's force, the key participant in the overhaul process, is a cornerstone of this foundation.

The overhaul of a ship, from the start of planning to the completion of the work, is accomplished through the cooperative efforts of the Type Commander (TYCOM), the PERAs (Planning and Engineering for Repairs and Alterations), the shipyards/SUPSHIPS, and the ship's force. All members of this team are specialists in the overhaul business, with the exception of the ship's force, who are operators as well as maintainers of their ship. They possess intimate knowledge of the equipment but, as a whole, are less experienced in the planning and execution of ship overhauls than any of the other participants in the process.

To plan and execute an overhaul effectively, the ship's force must know what to do and how to accomplish it in a timely manner, with a cooperative attitude toward the other participants in the overhaul process. It is doubtful that a successful overhaul can be achieved unless all of these elements are present.

Overhaul is an extremely complex operation and represents some of the most important uses of Navy fiscal assets. Because the various TYCOMs conduct their ship overhauls in somewhat differing manners, often with different terminology and emphasis, this section should only be taken as a representative outline of a Navy ship's overhaul. Each TYCOM has specific guidelines with which the EMO should become intimately familiar. The NAVSURFLANT Maintenance Manual (COMNAV-SURFLANT 9000.1) is the source used for this presentation (along with OPNAVINST 4700.7

(Series) for the major parts of material presented herein. However, other TYCOMs have similar documents and differ little in intent or major sequences of operation.

An example of the regular overhaul milestones (events that take place before, during and after overhaul) is presented in table 13-2. The EMO should always consult TYCOM references for reliable information.

Ships in the U. S. Navy shall undergo regular overhauls, at the intervals and durations set forth in OPNAVINST 4700.7 (Series), in order to accomplish major maintenance, modernization and conversion. The only work to be scheduled for accomplishment by shipyards will be those items which, in the judgment of the type commander, are beyond forces afloat capability because of manpower or resource constraints. All ships will receive a complete and thorough overhaul within available funding, in accordance with sound engineering practices. The primary overhaul objective will be to accomplish all outstanding repairs and major maintenance items to ensure reliable operation for the projected ship operational cycle. The ship has no scheduled operational commitments for the entire overhaul period. Overhauls are normally scheduled in each ship's home port area whenever practicable, with the planned duration of overhaul standardized by ship types. The actual duration may vary depending upon the amount and scope of industrial work and overhaul activity workload.

There are basically three distinct types of overhauls: 1. PERAs (See material on PERA following overhaul description.) Planned Regular Overhaul (ROH) using pre-overhaul test and inspection techniques and either the Ship Alteration and Repair Package (SARP) or an Integrated Work Package (IWP). 2. Non-PERA Planned Regular Overhaul using ship's force to define work on standard OPNAV Form 4790/2K. 3. PERA Planned Complex Overhaul (COH), so designated when required by the scope and size of the industrial effort.

Every ship overhaul requires the development of two basic work packages:

1. a modernization work package which includes NAVSEASYSOM and Type Commanders' authorized SHIPALTs,

SHIPBOARD ELECTRONICS MATERIAL OFFICER

Table 13-2.—Regular overhaul milestones

MILESTONE NO.	MILESTONE	CODE	ACTION COMMAND	TIME
1	Review CSMP and ensure that all ship deferred maintenance actions desired for accomplishment during ROH are documented, including Long Lead Time (LLT) items.	1	Ship	Continuous
2	Review SAMIS and prepare recommended list of Title "D" and "F" SHIPALTs for (TYCOM) type desk review.	1	TYCOM/PERA	A-30 to A-24 months
3	Issue Title "D" SHIPALT Authorization Letter.	1	TYCOM	A-24 months
4	Validate "D" SHIPALT Authorization letter	1	Ship	A-22 months
5	Issue NAVSEASYSKOM Advance Planning letter with initial funding for SHIPALTs based on FMP.	1	NAVSEASYSKOM	A-20 months
6	Issue PERA Advance Planning letter, SHIPALT guidance information, Scopes, and milestone assignments.	1	PERA	A-17 months
7	Scheduling of INSURV Material Inspection 1 and NAEC Helo Advisory Inspection.	1	TYCOM	A-16 to 12 months
8	Issue ROH guidance letter	1	TYCOM	A-16 to 12 months
9	Forward Automated Work Package to PERA	1	TYCOM	A-14 months
10	Pre-Overhaul Test and Inspection (POT&I) 1 (PERA Planned ROH)	1	PERA	A-360 to 300
11	Identify LLT items for TYCOM ALTs and Repairs.	1	PERA	A-360
12	Commence ordering LLT material for authorized Title "K", "D", "F" SHIPALTs and preauthorized repairs.	1	Overhaul Planning Activity	A-
13	Submit by message the JCNs for desired LLT work items (IWP work package only) (non-PERA planned ROH)	2	Ship	A-360
14	POT&I Report (PERA Planned ROH)	1	PERA	A-330 to 270
15	Shipcheck of Programmed Title "K" and "D" SHIPALTs	1	Overhaul Activity	A-330
16	Produce automated LLT work items and screen (IWP work package) (non-PERA planned ROH).	2	TYCOM	A-300
17	Deliver screened LLT work requests to Overhaul Activity (IWP work package)	2	PERA	A-290
18	Initiate Ship's Force Material Planning 1 and Procurement in accordance with COMNAVSRPLANTINST 9000.1, Article 4710.18	1	Ship	A-280
19	<u>Pre-overhaul Shipchecks and Inspections</u> 1 a. Shipcheck for repairs which may require design action b. Boiler Inspection (at start of overhaul) c. RAS/FAS winch test and inspections d. Feed/Fresh Water, Ballast, Fuel Oil Tank Inspections e. Combat Systems Inspections (non-PERA Planned ROH) f. Vibration Survey (non-PERA planned ROH) g. Submit Turbine Condition Report	1	Overhaul Activity Overhaul Activity, IMA or NAVSEC NAVSEC Overhaul Activity PERA/Overhaul Activity Overhaul Activity, Ship Overhaul Activity, Ship Ship	A-270
20	SFOMS Team visit to ship (Phase I)	1	PERA	A-270

Chapter 13—WORK BEYOND CAPABILITY OF SHIP'S FORCE

Table 13-2.—Regular overhaul milestones—Continued

MILESTONE NO.	MILESTONE	CODE	ACTION COMMAND	TIME
21	Submit by message JONs for Primary Work 2 Package (include LLT items and "D" ALTs/ AERs) (IWP work package) (Non-PERA Planned ROH)		Ship	A-250
22	Issue 240-Day SHIPALT letter with advance funding	1	NAVSEASYSKOM	A-240
23	Forward pre-ROH Combat Systems, Electronics, Tank Inspection Reports, and Vibration Survey report to TYCOM and overhaul activity	1	PERA	A-240 to 220
24	Schedule Thin Hull Inspection by DMA, (See Section 9110 for details)	1	Ship	A-210
25	Issue preliminary Ship Alteration and Repair Package (SARP)	1	PERA	A-210
26	SFOMS Training for Ship's Force (Phase II)	1	PERA	A-210
27	Forward screened copy of IWP work requests to overhaul activity (non-PERA Planned ROH)	2	TYCOM	A-210
28	Work Definition Conference	1	Overhaul Activity, PERA, TYCOM, Ship	A-200 to 140
29	Schedule pre-ROH and concurrent IMA availabilities	1	TYCOM	A-180
30	Provide ship with list of work items screened for IMA accomplishment	1	PERA	A-180 to 140
31	Provide supplementary repair work requests to TYCOM for screening. After A-115 only mandatory/emergent work requests will be accepted	2	Ship	A-135 thru A-115
32	Overhaul briefing for ship by COMNAVSURFLANT Type Desk Officer (non-PERA Planned ROH)	1	TYCOM	A-130
33	Complete Bid Specifications	2	SUPSHIP	A-120
34	Review Bid Specifications for errors, omissions, duplications	2	PERA/TYCOM/ Ship	A-120 to 105
35	Pre-arrival Conference to review Bid Specifications	2	SUPSHIP	A-110 to 105
36	Issue Solicitation for Bids to contractors	2	SUPSHIP	A-105
37	Ship inspection by contract bidders	2	SUPSHIP	A-105 to 90
38	Cancel SHIPALTs for which special program material, essential incidental installation material and/or design plans are not available unless, at the A-90 day point, the procuring or design agent can assure that the required material or plans will be available by the start of the ship's availability or, in the case of overhauls scheduled to take more than 9 months to complete, that it will be available at least 30 days prior to actual need.	1	NAVSEASYSKOM	A-90
39	Submit IMA Work requests	1	Ship	A-70
40	Implement SFOMS	1	PERA, Ship	A-60
41	Award ROH Contract	2	SUPSHIP	A-60
42	SARP turnover to SUPSHIP	2	PERA	A-60

SHIPBOARD ELECTRONICS MATERIAL OFFICER

Table 13-2.—Regular overhaul milestones—Continued

MILESTONE NO.	MILESTONE	CODE	ACTION COMMAND	TIME
43	Commence pre-ROH IMA Availability	1	Ship/IMA	A-30
44	Submit marked-up copies of Ships Selected Record Plans and Data to Overhaul Activity.	1	Ship	A-30
45	Provide ASF Funds	1	TYCOM	A-30
46	Offload Ammunition and Fuel as required (TYCOM approval required)	1	Ship	A-30 to 1
47	Ship enters Overhaul Activity	1	Ship, Overhaul Activity	A-1
48	Commence ROH	1	Ship, Overhaul Activity	A
49	Submit commence ROH message to CINCLANTFLT	1	TYCOM	A
50	Arrival Conference	1	Overhaul Activity, IUC, Ship	A to A+3
51	CASCAN all outstanding CASREPs which are scheduled to be corrected during ROH period	1	Ship	A to A+3
52	Submit Biweekly Progress Report in accordance with Article 4710.21	1	Ship	Biweekly
53	Commence crew training in preparation for Initial Lightoff Exam (LOE) by PEB	1	Ship, TYCOM, MTT	C-120
54	Prepare Dock trial, Fast Cruise, and Post-Repair Sea Trial agendas in accordance with Annex G	1	Ship	C-45
55	Post-repair Boiler Inspection	1	Overhaul Activity, TYCOM, Ship	C-45
56	Initial Lightoff Exam	1	PEB/Ship	C-40
57	Dock Trials	1	Overhaul Activity	C-30
58	Commence crew training in preparation for Post-Repair Sea Trials	1	Ship	C-25
59	Fast Cruise	1	Ship	C-20
60	Post-repair Sea Trials	1	Ship	C-15
61	Submit correction to Ships Equipment Configuration Accounting System (SECAS)	1	Ship	C-10
62	Post-overhaul Visual Tempest Inspection (with Configuration Control Diagram)	1	Overhaul Activity	C-10
63	Submit Post-repair Sea Trials Discrepancy Report	1	Ship	
64	Post-regular Overhaul Completion Review Conference	1	Overhaul Activity, Ship, TYCOM, IUC, PERA	
65	Complete Overhaul	1	Overhaul Activity, Ship	C
66	Submit ROH completion message to CINCLANTFLT	1	TYCOM	C
67	Submit CASREPs for inoperative equipment/systems	1	Ship	C
68	Post-overhaul PMS/CSMP update	1	Ship	C

Table 13-2.—Regular overhaul milestones—Continued

MILESTONE NO.	MILESTONE	CODE	ACTION COMMAND	TIME
69	Submit letter report of any unsatisfactory overhaul activity work (photographs and later updates also may be submitted)	1	Ship	C+10
70	Ready for sea period	1	Ship	Upon completion for min 7 days
71	Submit updated Ship's Characteristic Cards	1	Ship	C+10
72	Submit letter report of ASF expenditures	1	Ship	C+10
73	Load ammunition	1	Ship	As scheduled by TYCOM and ship
74	Report completion of all SHIPALTs, TYCOM AERs, Field Changes, ORDALTs	1	Ship	C+30
75	NAEC Helo Certification Inspection (As scheduled by TYCOM)	1	NAEC	C+30
76	Navigation Lights Inspection Report	1	Ship	C+60
77	End of guarantee period for work performed by contractors. All unsatisfactory work must be reported by this date in order to be corrected by contractor. Deficiencies discovered later should also be reported.	2	Ship	C+60
78	Forward Post-overhaul Analysis Report	1	PERA	C+90

NAVSEASYS COM authorized ORDALTs, Type Commander Alterations Equivalent to a Repair (AERs) and certain electronic field changes

2. a repair work package which includes all other repair work items for accomplishment by the industrial activity, ship's force or concurrent IMA

The increased complexity and size of ships has necessitated an increase in the amount of work done in industrial activities during regular overhaul periods. In turn, this situation results in the need for increased senior level management of both the industrial resources and ship resources to ensure that the ships are materially prepared to meet the requirements of the next operational cycle.

PERA-PLANNED REGULAR OVERHAUL

For most ships, a SARP is the document which defines and authorizes work to be done during the overhaul, assigns level of accomplishing activity for each work item, and

indicates cost estimates for each shipyard job. The IWP performs the same functions for small ships (ARS/ATF/MSO) when the OPNAV 4790.2K maintenance forms are arranged in order by ship system. The purposes of the SARP (or IWP) are as listed below:

1. integrates related customer work requirements
2. resolves redundant and conflicting work requirements
3. identifies work on a ship system basis
4. is the single source document for all customer authorized work

The SARP/IWP is maintained as a continuing document which contains the information necessary for:

1. estimating the overhaul cost and duration
2. early decision making by higher levels of command concerning budgeting, funding, operating schedules, and overhaul duration

3. commencement of additional advance planning, design work and material procurement by those activities responsible for supporting and conducting the overhaul

Key inputs for developing the SARP/IWP are as follows:

1. the Current Ships Maintenance Project (CSMP) as submitted by the type commander to the cognizant PERA approximately 12 months in advance of the ROH start date

2. results of the Pre-Overhaul Tests and Inspections (POT&I)

3. type commander Title "D" SHIPALT Authorization Letter

4. NAVSEASYS COM Title "K" SHIPALT Advance Planning/Authorization Letter

For ships employing SARP overhaul package (approximately 90 days prior to overhaul commencement, or when SARP screening action has been provided to ship) the following action will be taken:

1. Work discovered during POT&I, and which is designated for IMA accomplishment, will be documented on OPNAV Form 4790/2K and coded for an availability.

2. Work previously documented into the CSMP file, but which was originally coded for other than IMA accomplishment, and for which subsequent screening action changed the accomplishing activity to IMA, will require submission of a correction document (OPNAV 4790/2K) to change type of availability code.

The above work items, along with those already coded for IMA accomplishment in the ship's CSMP file (plus any desired master job catalog items), will form the IMA work package for pre-overhaul and concurrent IMAVs.

NON-PERA PLANNED REGULAR OVERHAUL

Specified Navy ships will undergo overhaul without benefit of PERA planning when the scope or location of the overhaul so dictates. This type of overhaul planning generally includes the same major steps as followed in

preparing for a PERA planned regular overhaul. The basic difference lies in the preparation of the work package for the Work Definition Conference (WDC). Preparation of the non-PERA planned work package will proceed as follows:

1. Type commander issues the Title "D" SHIPALT Authorization letter at A-24 months (see tab. 13-2).

2. Three hundred and sixty days prior to the overhaul start date, the ship shall submit by message to the Type Commander (TYCOM), information to the IUC, the JCNs (Job Control Numbers—see OPNAV 4700) for long lead time work items (including items requiring design action) desired for accomplishment during overhaul. Each JCN listed shall also include the deferred action taken code information as listed in OPNAVINST 4790.4. The TYCOM will then produce an automated work package containing these and selected pre-authorized baseline items, screen the work package, and deliver the authorized package to the overhaul activity.

3. Two hundred and fifty days prior to the overhaul start date, the ship shall submit by message to the TYCOM, information to the IUC, the JCNs for all work items desired in the ROH work package, including those JCNs for all previously approved long lead time work items. Title "D" SHIPALTs and TYCOM issued AERs (Alteration Equivalent to Repair) shall be included in the work list. The format of the message shall include for each JCN listed the following information:

- a. the deferred action taken code (see OPNAVINST 4790)
- b. the integrated priority number assigned to the JCN
- c. the letters "LLT" if the JCN reflected is a previously approved Long Lead Time work item

4. The TYCOM will then produce an automated work package containing these items for screening.

Loan of hand and power tools to ship's force is not covered by a job order. Ships assigned to a

naval shipyard for overhaul will be advised at the arrival conference of the procedure for borrowing tools. Ships assigned to a private shipyard in the general vicinity of the naval shipyard shall establish liaison with the naval shipyard for this purpose. Ships assigned to a private shipyard not in the general vicinity of a naval shipyard shall arrange for required hand tools with the applicable TYCOM maintenance type desk.

THE COMPLEX OVERHAUL (COH)

All nuclear powered and certain surface ship regular overhauls are designated as complex due to the scope and size of the industrial effort. Complex ship overhaul procedures include:

1. early and careful preparation of a list of needed alterations and repairs based on ship-check by experienced shipyard, ship and TYCOM personnel
2. early determination of and provision for equipments and materials required during overhaul for the needed alterations and repairs
3. early determination of trade-off actions required to make sure that alterations and repairs are given the best possible balance for post-overhaul readiness and are screened as necessary to permit accomplishment within time and fund constraints
4. the use of Ship's Force Overhaul Management System (SFOMS) is designed to make efficient use of ship's force by integrating its work with that of the shipyard. Planning and funding in accordance with the SFOMS procedures should commence concurrently with shipyard planning at least 1 year prior to commencement of the overhaul

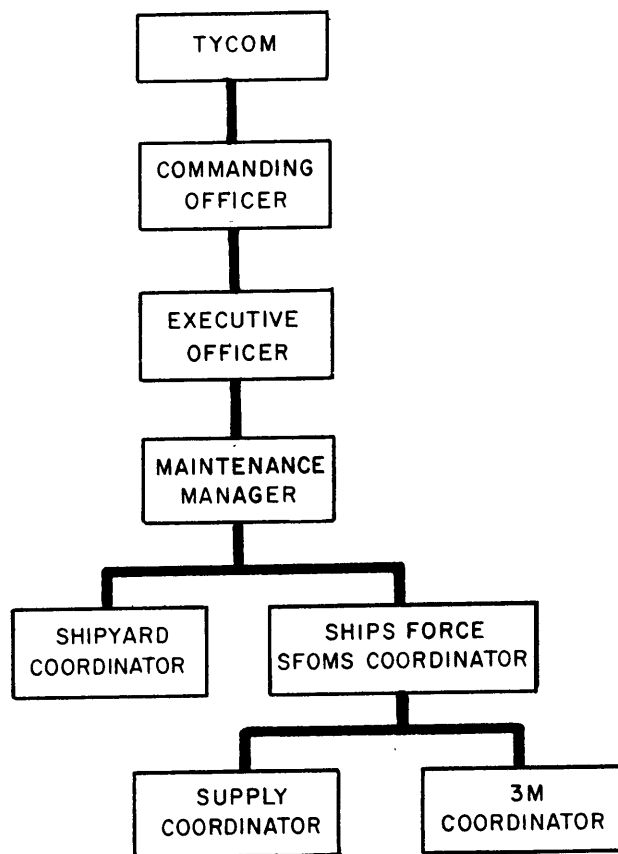
More effective management of resources is the continuing challenge at every level of command in the Navy. Spiraling costs, growing complexity of mechanical and electronic components, and limitations of funds, skills, and time available for proper maintenance of naval ships demands full use of the best management techniques. SFOMS provides certain management techniques for effective control of ship's force work during an overhaul. It provides the necessary elements for a smooth transition from

an operating environment to an industrial maintenance environment and minimizes interface problems between the ship's force and the shipyard (see the TYCOM maintenance manual for more information). A typical SFOMS staff organization is depicted in figure 13-2.

5. the assignment of a ship management officer in the shipyard (or supervisor's officer) for each complex overhaul

6. collocation of the shipyard and ship's force management staffs

7. a regular overhaul milestone certification program which provides for use of prerequisite lists to ensure equipment and systems are in fact ready for operation at key events such as LOE, light off, dock trials and fast cruise



SFOMS = SHIPS FORCE OVERHAUL MANAGEMENT SYSTEM
 SFWP = SHIPS FORCE WORK PACKAGE

Figure 13-2.—Typical SFOMS staff organization.

8. a standard Discrepancy Identification and System Checkout (DISC) program to provide a disciplined approach to discrepancy identification reporting and correction

9. frequent review of complex ship overhaul progress

EMERGENT ESSENTIAL REPAIR REQUESTS

Any repairs not identified prior to the submission of the primary work package or after the Work Definition Conference (WDC) will be classified as emergent essential repairs. As such they are limited to those repairs which have not been previously requested, must be completed during the overhaul, and cannot be deferred to a post-ROH intermediate or technical availability.

Emergent essential repairs must be requested by message to TYCOM, information copy to the overhaul activity, the Immediate Unit Commander, and the appropriate PERA. The message format in the TYCOM maintenance manual shall be used for requesting additional essential repairs.

It must be borne in mind that emergent essential repairs are extremely costly both in time and dollars. Failure to anticipate and plan ahead can have a significant, deleterious effect on ships of the force and delay return to unrestricted operations unnecessarily.

Emergent essential repairs shall be submitted as discovered after coordination with the overhauling activity.

PERAs

PERA (Planning and Engineering for Repairs and Alterations) is a program for improving the advance planning, integration, and control procedures associated with planning and engineering for repairs and alterations required for the overhaul of ships. The primary objective of the PERA Program is to provide intensive management for the accomplishment of effective, efficient, orderly and timely ship overhauls. This goal is reached through the

establishment of PERA offices. There are presently five (5) PERAs:

PERA(SS) —Submarines located at Portsmouth NAVSHIPYD

PERA(CV) —Aircraft Carriers and other Aviation type ships located at Puget Sound NAVSHIPYD

PERA(CRUDES) —Cruisers/Destroyers—located at Philadelphia NAVSHIPYD

PERA (CSS) —Combatant Support Ships located at NAVSHIPS Industrial Support Office (NISO), San Francisco

PERA(ASC) —Amphibious Ships and Craft located at Norfolk NAVSHIPYD

The PERA offices integrate the requirements of the various Systems and Type Commands, and manage the planning and engineering efforts for overhauls of assigned ship types and for vital interrelated programs. Based on ship modernization planning documents they assist the ship logistic divisions and type commanders in the development of class modernization and maintenance packages for assigned ships. The PERAs develop a complete and integrated ship overhaul planning work package which is fully useable by an overhauling activity with minimum translation and minimum additional planning. The work package is subject to the final approval of the cognizant parties, i.e., NAVSEA 04 for the alteration package and the type commander for the repair package, and shall be developed within the constraints issued by these cognizant parties.

While the EMO will be responsible for many publications during an overhaul, one of the most important for electronics is the updating of the Ship Information Book (SIB). Volume 4 of the SIB, Electronics Systems, must be made to reflect all new system installations and any system revisions accomplished during overhaul. The EMO must give personal attention to this important electronic publication. The book must be checked page by page, drawing by drawing, and line for line if a useful and dependable product is to be expected.

Advance Planning

The advance planning stage of the regular overhaul starts at least 30 months before the scheduled commencement of the overhaul. During this stage plans progress from the very rough stage to a refined and definite schedule. In the broad sense, advance planning provides a solid foundation for the consummation of work on naval ships in all shipyards. Availabilities of ships are approved by the Chief of Naval Operations on a fiscal year basis. Prior to approval, schedules are commented on by Forces Afloat and the Naval Sea Systems Command.

Factors considered in formulating the overhaul schedule are: (1) the home port of the ship; (2) the intervals between the previous overhaul availabilities of ship and the proposed overhauls; (3) the placing of ship in home shipyard or shipyards capable of performing any required special type of work; (4) the provision of a level of work in all shipyards to avoid laying off personnel intermittently; (5) the probable availability of critical material on important jobs identified as long lead time (LLT) jobs; and (6) any special factors that may arise. The final approved schedule represents the best compromise possible and is then used as a basis for planning by the material commands, the yards, and Forces Afloat.

In view of the remote, long-range nature of the schedule, changes and adjustments may be required from time to time. As the need arises, proposed changes are evaluated and approved or disapproved by the Chief of Naval Operations. Changes in start or completion dates may be made by the type commander, with the concurrence of the shipyard commander or SUPSHIP when the change is three weeks or less from the assigned date.

Advance planning on the part of the ship is necessary for a successful overhaul. The commanding officer must provide for the preparation of or make plans to cover the following:

1. Ship's force work
2. Training of ship's personnel during the overhaul
3. Security of ship's spaces, including protection against fire, flooding, theft, and sabotage

The plan for training during the overhaul period should outline the objective to be accomplished by the end of the period. Local training facilities and fleet schools should be utilized to the maximum degree consistent with obtaining a good overhaul.

Regular overhaul periods provide a time for personnel to clear up backlogs of leave accrued while the ship was in an operational status. The plans should provide for an equitable distribution of leave to personnel while maintaining a force of inspectors who are capable of inspecting work for the ship, and sufficient other personnel to ensure timely accomplishment of the ship's force work items. A period of turnover should be arranged between the return of one leave party and the departure of another.

While the ship is undergoing overhaul, special precautions against fire, flooding, theft, and sabotage must be taken. The shipyard is prepared to give assistance in matters of security, but the responsibility for establishing security measures remains with the ship.

Ship's Force Overhaul Management System (SFOMS)

Effective management of resources is a continuing challenge at every level of command in the Navy. Spiraling costs, growing complexity of mechanical and electronic components, and limitations of funds, skills, and time available for proper maintenance of naval ships demand full use of the best management techniques. SFOMS provides certain management techniques for control of ship's force work during an availability period, thus enhancing most effective utilization of ship's force during an overhaul. It provides the necessary elements for a smooth transition from an operating environment to an industrial maintenance environment.

Proper management of human resources by the commanding officer during the overhaul will provide a dependable, trained crew upon completion of the overhaul. At the same time, the ship's company must be provided with needed leave and recreation. SFOMS provides the tools to assist in attaining these goals. The system provides for a staff of shipboard personnel to schedule, manage, and control work to be accomplished by the ship's force. This is carried

out through (1) identifying work that must be performed, (2) determining what work force, materials, and facilities are required and available, and (3) developing cost estimates and schedules.

SFOMS is one of the tools available to aid in achieving an effective overhaul, that is, timely completion of work at least cost and minimum time, without sacrificing quality.

Post Repair Trials

Near the end of every overhaul during which major repairs are accomplished on machinery, appropriate trials are conducted to test the overall effectiveness of the repairs. The commander of the naval shipyard (or SUPSHIP) and the commanding officer of the ship determine the nature and extent of the post repair trials based on the work performed. A full-power trial should be scheduled following each regular overhaul to ascertain that the propulsion plant is capable of full power operation. The object of the post repair trials is to ascertain if the work has been completed, if the results sought have been fully accomplished, and if the ship machinery, weapons and electronics are in all respects, including QA certification, ready for service.

Post repair trials, if practicable, are witnessed by the Ship Superintendent, any shipyard (or SUPSHIP) personnel designated, and a duly appointed representative of the ship, to observe whether or not the work performed is satisfactory. When the overhaul is accomplished at a private shipyard, the contractor is permitted to have representatives on board to witness the trials.

DOCK TRIAL.—As soon as practicable after the work has been completed, the commanding officer directs the engineer officer to conduct a dock trial to ascertain the exact condition of the electrical and main propulsion plants. The trial is witnessed by the Ship Superintendent. Any defect, deficiency, or maladjustment discovered must be corrected or remedied, and another trial made. The dock trial is repeated until the condition of the engineering plant is reported satisfactory by the engineer officer.

SEA TRIAL.—As soon as practicable after completion of the dock trial, when the persons responsible for the adequacy of the work are satisfied that the equipment is ready in all respects, a sea trial is conducted if the shipyard commander (or SUPSHIP) and the commanding officer consider it necessary. The trial is conducted by the commanding officer. The conditions of the trial are determined mainly by the character and magnitude of the work that has been performed, and the trial is conducted in such a manner as the commanding officer and the naval shipyard commander (or SUPSHIP) deem necessary and sufficient. A full power trial, if required, is conducted during the sea trial, except when the commanding officer considers it desirable to delay such trial until new machinery parts have been properly run in and the training status of the crew will permit full power operation of the propulsion plant without undue hazard to the machinery.

This is an especially critical time for electronics personnel. It is the first time that newly installed, repaired, or modified equipment operation can be inspected under actual operational conditions without being landlocked.

Readiness for Sea

Normally, the cognizant type commander allots the ship a readiness for sea (RFS) period immediately following the overhaul. This provides time for the ship's force to complete additional preparations prior to return of the ship to unlimited operational status. The time may be used (1) to load ammunition and supplies, (2) for special exercises and maneuvers at sea, or (3) to prepare for a special mission. The RFS period allotted to a ship will not normally exceed seven days, and frequently it will be less. If there is an immediate special operational need for the ship, the RFS period may be omitted entirely. Neither the shipyard commander nor SUPSHIP are permitted to use the RFS period for the accomplishment of work items that the shipyard has been unable to complete prior to completion of the overhaul. If additional time is needed by the shipyard, an extension of the availability should be requested from the cognizant type commander.

THE SHIP SUPERINTENDENT

The Ship Superintendent is the representative of the Repair Superintendent who, in turn, represents the Production Officer. The Ship Superintendent is responsible for coordinating, arranging, and accomplishing authorized work on a ship during its availability in the shipyard.

It is customary to assign a Ship Superintendent a considerable period in advance of the ship's arrival in the yard.

During the interval before the ship arrives, the Ship Superintendent needs to obtain and study a considerable amount of information:

- Departure report for the last availability of the ship in the shipyard
- Copies of all outstanding job orders and work requests issued to the ship in order to obtain a familiarity with the current jobs
- Information from the current type desk officer concerning time and place of the Arrival Conference
- List of proposed work
- List of civilian planners and estimators assigned to the ship
- Time of ship's arrival and berth assignment
- Booklet of plans from the Planning Department to determine general ship arrangements
- List of civilian shop supervisors assigned to the ship
- List of special jobs requiring immediate attention
- Information on lengthy and/or complex jobs

From 18 to 24 hours before the ship is due to arrive in the yard, the Ship Superintendent ascertains that the service shops are informed of the berth assigned and the time of arrival. Shop

72 furnishes riggers for the placement of the brow; and Shop 99 (temporary service) provides for steam, water, and air connections, shore power, and telephones.

The Ship Superintendent is at the dock when the ship arrives and ties up, and makes certain that the required services are promptly furnished. (The Ship Superintendent is one of the first contacts the ship has with yard personnel and throughout the overhaul is, in fact, the liaison with the yard.) Upon first arriving aboard ship, the Ship Superintendent delivers to the commanding officer (or to the executive officer if the commanding officer is absent) copies of orders and regulations which outline and specify procedures on points mutually affecting the shipyard and the ship.

Among the subjects covered are: (1) the appointment of ship inspectors for the overhaul, (2) the requirement for fire watches for various types of work, and (3) general shipyard information for ships. As soon as the ship's force is secured from the mooring maneuver, the ship superintendent requests a meeting with the heads of departments. At the meeting the ship is (1) notified of the time and place of the Arrival Conference, (2) advised of the urgent necessity for fire watches, the basic organization and duties of fire watches, and the place and manner of obtaining portable fire extinguishers, and (3) requested to furnish a suitable place on board ship to serve as a ship superintendent's office for the duration of the overhaul.

The shipyard commander conducts frequent (usually weekly) conferences with the commanding officer of each ship in the shipyard, to review the progress of work on the ship. The Ship Superintendent and other appropriate shipyard supervisory personnel also attend the conference. Because of the responsibility for the production, coordination, and progress of jobs, the Ship Superintendent must carefully monitor the performance of work in key jobs. During the course of the overhaul there are frequent conferences with shop personnel, ship personnel, the cognizant type desk officer, progressmen, and other yard personnel, to ensure a timely completion of all authorized work.

Quality Assurance (QA)

Quality assurance is a term that is synonymous with the Navy's concern over the quality of workmanship performed on Navy ships. This concern is embodied in Quality Assurance programs (usually type commander instructions) which provide a framework for determining the degree of certainty of ship performance readiness.

The QA Program is intended to improve equipment reliability, safety of personnel, and configuration control, thereby enhancing ship readiness. The wide range of ship types and classes and equipment differences within ship classes complicates maintenance support and increases the need for a formalized program that will provide a high degree of confidence that repair actions will consistently meet conformance standards. The basic program is promulgated by CINCLANTINST 4355.1/CINCPACFLTINST 4355.1 with amplifying guidance in the type commander's instruction. Together these documents set forth the minimum QA requirements and procedural guidance for all Navy ships.

The goals of this program are to protect personnel from hazardous conditions, increase the time between equipment failure and ensure proper repair of failed equipment.

The instructions contained in QA manuals apply to every ship and activity of the Navy. While primarily applicable to the repair/maintenance accomplished by Intermediate Maintenance Activities (IMA), the requirements also apply to ship's force when performing maintenance on their own ship. In all cases, specifications must be met and if such is not the case, then a Departure from Specifications Request must be recorded and reported. Departures from specifications must also be reported to appropriate levels so that departure approvals or restrictions may be issued.

Because of the wide range of ship types and equipments, and the varied resources available for maintenance and repair, the information set forth in this text is necessarily somewhat general in nature. Each activity must implement a Quality Assurance Program to meet the intent of the type commander's QA manual. The goal is

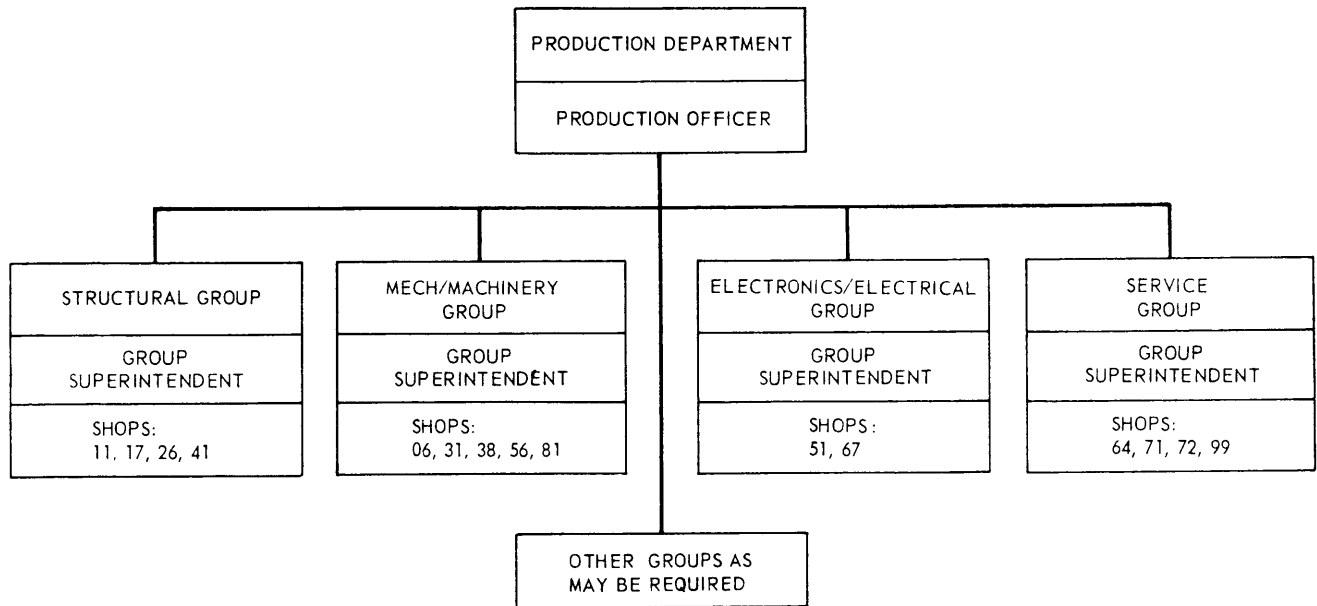
to have repairs in conformance with specifications.

SHOPS

A shop in a naval shipyard is a unit assigned certain specific work, usually by trades, and manned with specially trained and qualified personnel adept in the type of work assigned. The shop usually performs its peculiar type of work for the entire yard. Most of the shops are assigned to the Production Department. (Transportation, Shop 02, power plant, Shop 03, and maintenance, Shop 07, are assigned to the public works department.) All Production Department shops are under the supervision of the Production Officer. Each shop group is under the control of a civilian Group Superintendent.

A typical Production Department shop group organization is shown in figure 13-3. Each shop is assigned a number and a name. Certain shops are not located in some shipyards; some shops, however, are common to all shipyards. At some shipyards, certain shops may be combined with another shop. The following is a list of Production Department shops, by number and name, common to all naval shipyards:

- 06 Central Tool
- 11 Shipfitters Shop
- 17 Sheet Metal Shop
- 26 Welding Shop
- 31 Inside Machine Shop
- 38 Outside Machine Shop
- 51 Electric Shop
- 56 Pipe and Copper Shop
- 64 Woodworking Shop (may include Shop 94, Pattern Shop, in some shipyards)
- 67 Electronics Shop
- 71 Paint Shop
- 72 Riggers and Laborers Shop (may include Shop 74, Sail Loft, in some shipyards)
- 74 Sail Loft
- 99 Temporary Service Shop



64.16A

Figure 13-3.—Shop group organization of the production department.

The following is a list of Production Department shops, by number and name, located only in certain shipyards:

- 23 Forge Shop
- 25 Gas Manufacturing Shop
- 27 Galvanizing Shop
- 35 Optical Shop
- 36 Weapons Shop
- 37 Electrical Manufacturing Shop
- 41 Boiler Shop
- 68 Boat Shop
- 81 Foundry
- 94 Pattern Shop
- 97 Ropewalk

Each shop in the Production Department is assigned to a shop group consisting of one or more shops. The shop Group Superintendent, in charge of each shop group, is responsible to the Production Officer for (1) the organization and administration of the respective shop group and of the shops within the group; (2) the training and supervision of the personnel assigned;

(3) the coordination and overall guidance of the work of the shops within the group, aimed at orderly progress, timely and economical job completion, and effective use of manpower in conformance with safe practices and job specifications; and (4) the maintenance of good order, cleanliness, and discipline in the spaces used.

A superintendent (fig. 13-4) is in charge of each Production Department shop, and is responsible to the shop Group Superintendent for the organization and administration of the shop. The Superintendent is assigned clerical, administrative, and technical assistants as necessary to ensure: (1) effective use of manpower; (2) conformance with safe work practices and job specifications; (3) orderly progress and timely completion of job orders; and (4) proper maintenance of personnel and shop records.

SUPERVISOR OF SHIPBUILDING, CONVERSION AND REPAIR, USN COMMAND

The standard tasks and functions assigned to Supervisors of Shipbuilding, Conversion, and

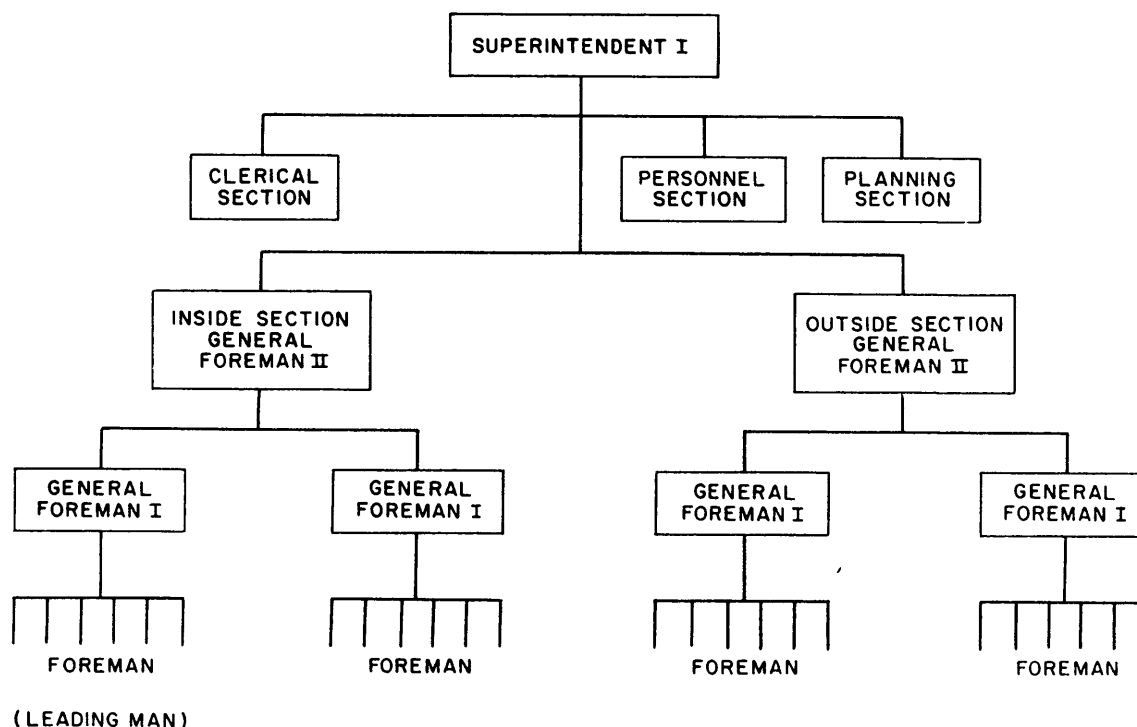


Figure 13-4.—Organization of a typical production department shop.

64.16B

Repair, USN, in the accomplishment of their assigned missions are (in part) as follows:

1. Administer Department of the Navy and other Department of Defense shipbuilding, design, conversion, and facility contracts at assigned private shipyards

2. Procure and administer overhauls, repairs, alterations, activations, and inactivations performed on naval ships at assigned private shipyards under Master Contracts for Repair and Alterations of Vessels

3. Perform contract administration services for all Department of Defense contracts awarded to plants assigned in accordance with the plant cognizance program

Additional information concerning SHIPALTS, ships' work requests, and SUPSHIP procedures can be obtained from the Ship

Repair Contracting Manual (Repair Manual), NAVSEA 0900-LP-079-5010.

ELECTRONIC FIELD ENGINEERS AND TECHNICAL ASSISTANCE

In addition to the repair assistance available at shipyards or alongside repair ships and tenders, ships may request assistance from electronic field engineers except when in a shipyard. These are civilian electronics personnel from commercial firms which are under contract with the Naval Ships Systems Command or Naval Electronics Systems Command as appropriate. However, the EMO's first call for assistance must be to MOTU and then to TYCOM.

Field Engineer services are obtained by request to the appropriate operational or type commander. On-call engineering services are

arranged by the appropriate systems command if the requested services are not already available through the Mobile Technical Units (discussed in the following paragraphs).

Ordinarily, electronics work assigned to or undertaken by field activities of the NAVSEA, NAVAIR, or NAVELEX is accomplished by naval military and civilian personnel. However, when necessary, the Naval Sea Systems Command or the Naval Electronics Systems Command will provide the professional services of electronic field engineers.

These engineers provide technical information to naval military and civilian personnel on unusual design, planning, installation, and maintenance problems associated with the introduction of new equipment. The major justification for their use, however, is their contribution in helping naval personnel to perform their duties more efficiently through training. At naval shipyards, for instance, they train and instruct shipyard personnel in the installation, checkout, and adjustment of equipment. Shop personnel are given detailed information on the fine points of equipment maintenance and techniques. On board ships, electronic field engineers familiarize the ship's force with the adjustment, maintenance, and operation of installed electronic equipment.

In addition, electronic field engineers train naval personnel at regularly established schools. These schools usually provide classroom instruction on newly controlled equipment.

MOBILE TECHNICAL UNITS

The mission of the Mobile Technical Units (MOTUs), is to improve fleet electronics and weapons readiness by providing a cadre of versatile, highly skilled technical personnel under fleet control, which promotes the achievement of technical self-sufficiency of the operating forces primarily through on-the-job training (OJT) in maintenance or operation of electronics and weapons equipments through responsive technical assistance beyond the capability of Forces Afloat, when and where needed, to effect repairs not requiring the facilities of an industrial activity. In order to accomplish this mission each MOTU is staffed by a group of highly qualified senior Navy

technicians and civilian technicians who provide OJT and technical services to units of the Navy. MOTUs are located as follows:

<u>MOTU</u>	<u>LOCATION</u>
MOTU TWO	Norfolk, VA
MOTU FOUR	Groton, CT
MOTU SIX	Naples, Italy
MOTU TEN	Charleston, SC
MOTU TWELVE	Mayport, FL
MOTU FIVE	San Diego
MOTU NINE	Treasure Island
MOTU ONE	Pearl Harbor
MOTU SEVEN	Yokosuka
MOTU THIRTEEN	Subic Bay

MOTUs provide the following services, to the extent of their technical capability and manning, for units of the Navy:

1. On-the-job training (OJT) to fleet personnel in electronics and ordnance equipment maintenance
2. Technical assistance in the repair and installation of electronic and ordnance equipment, where such work is beyond the capabilities of forces afloat
3. Informal short course maintenance instruction on selected equipment, either on board ship or at the local MOTU
4. Electronic and weapon systems grooms, checks, reviews, or inspections for surface and submarine units
5. Shipboard AN/ULM-4 facility services as required by Fleet Commanders
6. TACAN operational checks at various major facilities
7. Other assistance in the field of electronic and weapon systems not specifically listed above, where such assistance is within the capability of the MOTU and compatible with their assigned mission

Requests for technical assistance will be made only after all efforts by the ship's force have failed to correct the problem and assistance from ships in company is unavailable or unsuccessful. Requests will be made in time to permit work completion during normal working hours. Overtime will normally be authorized only for emergency services to meet operational commitments. A CASREP or message request for technical assistance is required in such cases. Since MOTUs provide mutual technical support, it may be necessary for one MOTU to travel in support of another MOTU. This travel will not be performed in response to an informal request for technical assistance. Refer to COMNAV-SURFLANTINST 9400.1 (Series) or COMNAVLOGPACINST 9670.1 (Series) for further information.

Requests for training quotas and information concerning training will be made directly to the local MOTU. This training is available as OJT conducted on board ship or at the MOTU unit and through informal training courses. Both are designed to promote technical self-sufficiency of fleet personnel through instruction in practical maintenance and operational understanding of their equipments.

When services are provided, it is mandatory that the enlisted technicians regularly assigned to the equipment be present and available when MOTU personnel are on board. Ship's technicians are to perform the work required, advised and assisted by MOTU personnel. The cognizant EMO will be present to coordinate details as required. The ship will provide calibrated test equipment in working condition, technical manuals, repair parts, Maintenance Requirement Cards (MRCs) and adequate working facilities so that MOTU personnel may carry out their assignment promptly and efficiently. Where required and practicable, transportation assistance will be made available or arranged by the ship to minimize lost time and travel expense.

MOTU working hours normally commence at 0800 and efforts will be made to assure maximum utilization of MOTU personnel services during a full normal working day. This does not preclude utilization of overtime hours when operational commitments clearly call for it.

Whenever MOTU personnel are embarked outside the local MOTU area, initial arrival and final departure times of these personnel will be reported. This, in addition to timely Situation Report (SITREP) messages, will keep all concerned advised of the work status, and the need for additional assistance such as part procurement, and will assist in the efficient utilization of personnel by advising when the technicians will be available for reassignment.

MOTUs will give first priority to CASREP and situations which affect primary mission readiness. Routine checks and inspections are to be scheduled as resources allow and must be within the purview of the MOTU mission statement. MOTUs will not provide numerical "grades" for inspections but rather a report of material conditions found, and recommended corrective action.

Ships receiving assistance from MOTU technicians will provide appropriate personal support, such as mail, laundry, and administrative assistance, as necessary. Civilian contract employees have been certified by Chief of Naval Operations as U. S. Navy Technicians. The technicians are normally afforded the privileges of commissioned officers in such matters as messing, berthing and transportation. On board subsistence must be at no direct expense to the Government.

Navy Technicians are assigned for the purpose of providing technical assistance and training, and will not be utilized as augmentation of ship's force for other purposes. Messing, berthing and transportation are to be furnished, where practicable, in keeping with their rate.

NAVAL SEA SYSTEMS COMMAND DETACHMENTS

The Naval Sea Systems Command Detachments were created to deal with the increasing problems associated with shipboard equipment maintenance. Although the Naval Sea Systems Command has kept active surveillance over problems of maintainability, reliability, and availability, need has been felt for a more direct line of communication with shipboard personnel responsible for electronic maintenance, with industrial activities which

support the fleet, and with the manufacturers who design and build the equipment.

The detachment is not a maintenance activity, as such, but rather an engineering management arm of the systems command, organized to resolve maintenance problems by taking or recommending remedial action. The detachment is concerned with maintenance in its fullest sense—design, installation, training, logistics, and technical information. It is organized with the following major divisions:

1. ASW
2. Radar and tactical data systems
3. Engineering and logistic support
4. Combatant craft engineering

Each division is subdivided into branches with project engineers and technicians assigned to exercise engineering maintenance management over each piece of equipment assigned.

The routine duties of NAVSEASYS-COMDET include: investigation of maintenance deficiencies and trouble reports; engineering analyses and corrective recommendations; preparation of maintenance tips and procedures; development of field changes; reliability and maintainability analyses; training and manpower studies; and revision of technical manuals, maintenance standard books, and other documents. In addition, information gained from shipboard experience is furnished to the systems command for continued improvement in new design.

Casualty reports, maintenance reports, and investigations are made for corrective measures. Field changes are studied and are released as developed. Articles and helpful maintenance tips appear in the Electronics Information Bulletin (EIB). For equipment assigned, Maintenance Requirement Cards receive final engineering approval.

Experience and information gathered from maintenance reports, casualty reports, and shipboard interviews are applied to the research and development program and manufacturing stages to prevent future maintenance problems. Test points and test facilities will be carefully scrutinized, and maintainability and reliability emphasized.

Electronic equipment reliability and maintenance require the coordinated effort of the military and industry. The specification writer, designer, manufacturer, inspector, installer, operator, technician, and others must all share in improvement of equipment.

NAVAL ELECTRONIC SYSTEMS COMMAND FLEET LIAISON PROGRAM

Forces afloat are the highest priority customers of NAVELEXSYSCOM. The general reduction in operating Naval Forces requires concentrated efforts by NAVELEX and its field activities to provide the maximum achievable availability of our ships' mission—essential electronic systems to allow realization of Navy operational mission commitments. NAVELEX technical logistic support capability is maintained, consistent with workload experience and resources available, to ensure quick response to fleet requests for assistance beyond the capability of ship's force. The implementation of the Fleet Liaison Program established direct lines of communication and provided "one-stop shopping" sources for support necessary to meet fleet operational requirements.

Operational maintenance support and assistance is supplementary to that normally provided through type commanders and Mobile Technical Unit (MOTU) resources. The Fleet Liaison Office also provides advice and consultation services as requested by operating forces in the subject areas listed below:

1. material support information
2. administrative procedures
3. technical data
4. resolution of interface and compatibility problems
5. safety problems
6. configuration and field change problems
7. equipment maintenance
8. on-the-job and informal training not readily provided for elsewhere

A primary goal of the Fleet Liaison Program is to provide a single point-of-contact for the fleet in electronic matters by receiving,

investigating, and evaluating problem areas, to include requests for technical assistance. The Fleet Liaison follow-on procedure after investigating a problem area is to recommend, initiate, and coordinate corrective actions.

Technical assistance requests for NAVELEX cognizant equipment should be made in accordance with fleet instructions, and then directly to the Naval Electronic Fleet Liaison Office nearest the requesting activity. The exception to this rule would be for technical assistance for equipments that COMNAVSURFLANT and COMNAVLOGPAC know from previous experience cannot be handled by the nearest Fleet Liaison Office. However, if the requester does not know where available expertise is located, the Fleet Liaison Office nearest the requesting activity should be contacted to provide assistance in locating the required technical services capability.

There are six NAVELEX Field Activities having Fleet Liaison Offices: NESEC Washington, NESEC Charleston, NESEC Portsmouth, NESEC San Diego, NESEC Vallejo and NESEA St. Inigoes, Maryland. Additionally, NAVELEXSYSENGCEN DET Mayport has a Fleet Liaison Officer assigned.

FLEET MODERNIZATION PROGRAM (FMP)

Ship alterations and improvements are programmed for accomplishment by the CNO approved Fleet Modernization Program (FMP). This program was developed by CNO in accordance with operational requirements and in conjunction with the Fleet Commanders in Chief and the Chief of Naval Material. The FMP is executed by COMNAVSEASYSKOM, acting as executive agent for CHNAVMAT and as directed by CNO.

Several terms are used when discussing the FMP and are presented as follows:

1. Military Improvement. A military improvement is one which results in a change of a ship's operational or military characteristics, qualities or features, which increases the ability of the ship to perform its required operational capabilities (ROC). The decision to incorporate

a proposed military improvement rests solely with CNO.

2. Proposed Military Improvement (PMI). When, as early in the development cycle as possible and preferably prior to undertaking engineering development, a new equipment or system shows sufficient promise to warrant consideration for installation, the sponsor will submit a PMI to CNO. The impetus for a PMI may originate from any source: industry, R&D, fleet, hull, equipment or program sponsors, systems commands or an individual. When the PMI is approved it will provide (1) a vehicle by which the proposed improvement can be coordinated with all programs scheduled for installation in U. S. Navy Ships, and (2) a base which CHNAVMAT can use to develop design guidance and ship alterations.

3. Military Improvement Plan (MIP). A military Improvement Plan (MIP) lists all military alterations for a particular class of ship and is arranged in priority order by the Ship Acquisition and Improvement Panel—Working Group (SAIP—WG). A MIP is approved by CNO.

4. Technical Improvement. A technical improvement is one which results in a change to improve the safety of personnel and equipment and/or provides increased reliability, maintainability and efficiency of installed equipments. A technical alteration should not be of such magnitude as to encompass major system changes which would more logically be classified as a military improvement. Technical improvements may be either a ship or ordnance alteration and are approved by the applicable SYSCOM under the command of the CHNAVMAT.

5. Technical Improvement Plan (TIP). A Technical Improvement Plan (TIP), approved by CHNAVMAT, lists in priority order all technical improvements for a particular class of ship.

6. Amalgamated MIP/TIP (AMT). The AMT is an integrated priority listing of the military and technical alterations in the MIP and TIP of a particular ship class. In determining the integrated AMT priorities, due consideration is given to grouping MIP items together with associated TIP items.

7. Emergent Requirements. An emergent requirement is one which arises during the execution year of the FMP. It can involve adding new improvements or matters associated with the authorized improvements in the FMP to be accomplished during the ship's overhaul or restricted availability. The changes are originated by the SYSCOM, FLTCINC, type commander or within OPNAV. For those emergent requirements associated with items in the FMP or AMT integrated priorities, approval is requested from CNO (Op-43); for those not in the FMP or AMT, from CNO (Op-097). Emergent requirements will be added to the current year FMP by compensation within the FMP or by reprogramming. Any changes recommended for the execution year should be thoroughly studied to ensure material is available, feasibility has been established and any interface problems with other ship systems have been identified and resolved. Message changes to the execution year FMP are serialized by CNO for CHNAVMAT management purposes.

The Fleet Modernization Program (FMP) is an integrated program combining military improvements from the MIPs, technical improvements from the TIPs and selected type commanders' improvements arranged by individual hull, based on scheduled ship overhauls and restricted availabilities plus related nonhull identified program funding requirements (e.g., design, planning, COSAL, service craft ALTS, etc.). The FMP consists of improvements drawn from the AMT in a priority order which are applicable to specific ships on a year-by-year basis within a five-year period. The execution year program of the FMP forms the basis for implementing current year improvements as funded.

SUPPORT AND TEST EQUIPMENT ENGINEERING PROGRAM (STEEP)

A major technical problem and excessive expense for the Navy has been the replacement of inoperable printed circuit boards (pcb). Technological change in equipment design has

changed repair philosophy from that of component replacement to that of module replacement for most modern equipment.

Faulty modules are returned to the supply system in exchange for a replacement module. The damaged module then is processed for contractor repair, repair within the Navy establishment, or is discarded, all at great expense to the Navy. To address this problem, the Navy's 2M (Miniature/Micro-Miniature) repair program was instituted. Highly trained personnel made repairs to many of these modules at the Intermediate Maintenance level. Under this program another problem became apparent in that many of the modules required complex signal inputs, frequently different for each module, to determine malfunctions, before repairs could be effected.

The STEEP is designed to do this for a variety of pcb's. Studies by Navy pilot facilities during 1979 indicated that as many as 67% of the returned "inoperative" modules were actually not inoperative when tested using STEEP's Automatic Test Equipment (ATE).

STEEP, at this writing, is not fully implemented. The primary objective of the program is to create a support policy and structure for surface ship electronic systems based on the use of ATE. The ATE initially selected with this capability was the GENRAD 2225, a bench-top test set for shore Intermediate Maintenance Activities (SIMAs).

The GENRAD 2225 is an automatic programmable test set capable of performing GO/NO-GO testing of digital pcb's and fault isolation with a guided logic probe. The test set also has some capability of testing analog devices, but this is quite limited. Using high speed processor capability, it can generate pseudo-random test patterns. This unit is considered to be a state-of-the-art, third generation benchtop automatic tester. The set also incorporates self-test procedures which are conducted by SIMA personnel at the beginning of each workday. The test procedures reveal which subassemblies, electronics modules, or printed circuit boards, if any, within the test set need to be replaced. These are replaced from a spares kit/or maintenance kit provided with each test set.

MINIATURE AND MICROMINIATURE ELECTRONIC REPAIR AND CERTIFICATION PROGRAM (2M)

Increased utilization of microcircuit devices, complex packaging, multilayer construction, and miniaturization of discrete components, have resulted in the requirement for new methods and techniques for removing and replacing miniaturized electronic components.

Naval Air Systems Command (NAVAIR-SYSCOM) has developed and implemented an effective Aviation Module Repair Improvement Program (AMRIP), which identifies proper repair techniques, skills required, depth of training needed, and repair equipment necessary to perform satisfactory repairs imposed by state-of-the-art electronics design, after the faulty component(s) have been identified.

The NAVAIR Program is designed for maintenance of avionic modules and avionic ground support equipment. Using the NAVAIR Program as a model, Naval Sea Systems Command (NAVSEASYSYSCOM) developed a program (2M program) which is incorporated into NAVSEA 4790.17, and which is designed to meet surface and sub-surface requirements. Although the NAVSEA program differs somewhat from the NAVAIR program, the two have similar training, inspection and repair techniques, and equipment and supply support requirements.

The NAVAIR experience in developing the AMRIP program has demonstrated the necessity for establishing a baseline of effective quality assurance to prevent degradation of maintenance performance. NAVSURFLANT's INST 9400.2 defines their 2M program and is similar in concept and authority.

Certain definitions are important and are provided:

1. Microelectronics. That area of technology associated with or applied to the realization of electronic systems from extremely small electronic parts or elements.

2. Microcircuit. A network having a high equivalent circuit element density, which is considered as a single part composed of interconnected elements on or within a single substrate to perform an electronic circuit function. Typically, this includes integrated circuit packages

including, but not necessarily limited to, TO can, Dual-in-line and Flat Pack type packaging.

3. Microcircuit Module. An assembly of microcircuits, or combination of microcircuits and discrete conventional electronic devices, performing one or more distinct functions in an electronic equipment, constructed as an independently packaged, replaceable unit. Typically, this includes plug-in printed wiring boards and circuit card assemblies.

4. Miniature Component Repair. Miniature component repair consists of basic repairs performed by a specially trained technician using special tools and equipment on electronic modules, including some microcircuit modules, but largely characterized by common discrete components mounted on single or double-sided laminate, relatively low density packaging and generally simple module construction.

5. Microminiature Component Repair. Microminiature component repair consists of complex repair procedures by highly trained and skilled technicians, using special tools and equipment, on electronic modules characterized by miniature and microminiature components, hard to remove conformal coatings, susceptibility to damage, complexity of laminates, multilayer construction, (three or more layers), and high density packaging of discrete components.

The program provides for tasking only certain shore and afloat activities with requirements to set up and operate the program. This includes the selection, training and certification of personnel to perform the maintenance on defined microelectronics and the outfitting with special equipment/tools to perform the mission. No other personnel are authorized to perform this work. MOTUs provide inspectors who are charged with certification and inspection responsibilities. References are provided as follows:

1. NAVAIRINST 4790.7
2. NAVMATINST 4790.19
3. NAVMATINST 4790.22
4. NAVSURFLANTINST 9400.2
5. NAVSEAINST 4790.17
6. NAVSEAINST 440.12